

# ON SOME NEW AND OLD SPECIES OF CARBONIFEROUS FOSSILS.

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The contents of the accompanying paper are of a miscellaneous character, but may be classified from one point of view into species which I expect to discuss before long in other reports and which are not provided with illustrations in the present one, and those which are not included in plans for the immediate future and are consequently illustrated in this place. These last group themselves into several categories.

Several years ago when collecting in Kansas I obtained at a locality near Chanute some fossil sponges in unusual abundance and perfection of preservation. A careful study of these forms seems to justify recognizing among them four new genera, five new species, and one new variety.

Over half a century has elapsed since Isaac Lea published his brief paper on the occurrence of fossil mollusks in the anthracite seams of the Carboniferous at Wilkesbarre.<sup>a</sup> Though our knowledge of the coal plants of the anthracite region has since become very extensive, time has brought out few facts relating to the invertebrates of that place and period. The fauna of the Mill Creek<sup>b</sup> limestone has subsequently been discovered and partially described, but it is evident that this fauna is not the same as that which furnished Lea's specimens. It is unfortunate, therefore, that the last-named author does not state more precisely where and from what seam his material had its source, doubly unfortunate in view of the fact that even his poor figures show plainly that his species were in some cases based upon mere fragments.

When a storage box containing miscellaneous and some unlabeled specimens was unpacked several years ago a small slab of black sandy

<sup>a</sup> Acad. Nat. Sci. Philadelphia, Jour., 2 ser., II, 1853, p. 203.

<sup>b</sup> Wyoming Hist. and Geol. Soc., Proc. and Coll., II, 1886, p. 265 et seq., and 2d Geol. Surv. Pennsylvania, Ann. Rept. for 1885, 1886, p. 450.

shale with invertebrate fossils was fortunately recognized as containing the types of all Lea's species, and these upon the present occasion it is my purpose to supply with somewhat better illustrations than the original ones. There is little remedy in prospect for the imperfectness of the type-specimens themselves, since, as just stated, the original locality was not described and the horizon has not been rediscovered, so that the species can not be rehabilitated upon better material.

Of the five invertebrate species described in Lea's paper two are based upon such mere fragments that it is doubtful if they could be definitely fixed, even with additional material from the same fauna. A single species is unquestionably valid, while of the two remaining, one is with little doubt identical with it and the other is probably the same as a species already in the literature.

Lea's remark, therefore, that "As these forms are the only ones yet found that I am acquainted with, I have deemed it better to give an exact representation of the specimen itself and to give provisional names, that geologists may be able to recognize them when met with again," seems tinged with unconscious irony.

The remaining species, three in number, are of somewhat unusual interest. One of these belongs to the genus *Harttina*, a type of structure hitherto known only in Nova Scotia, while the two others, which represent the genus *Tegulifera*, are interesting not only on their own account but because that genus has as yet been found only in Europe, the original species having been obtained in the Carnic Alps, while a second doubtful representative has been described from the Ural Mountains.

#### HETEROCÆLIA, new genus.

General shape moniliform, consisting of subspherical units joined end to end in straight or nearly straight lines; sometimes branching. Each unit consists of a spherical outer wall interrupted at both ends by the passage of a large cylindrical cloaca, which is continuous from cell to cell. The outer wall is interrupted also by large spout-like ostia.

The mode of growth of this organism is not quite clear from the material examined. There is some evidence that the cylindrical cloaca may have been first prolonged, or in perfect specimens may normally have projected from the upper end, and that upon this the spherical outer wall was formed. The constituent spheres are sometimes just in contact, but sometimes also they appear to be separated by an interval bridged only by what seems to be a section of the cloaca. On the other hand, two consecutive spheres may overlap, in which case the lower end of the upper or younger one is invaginated. In any event the two cells even when in contact have discrete spherical walls throughout. The cylindrical cloacal walls seem to be

continuous from cell to cell, but not only do the cloacæ of the entire system, so far as observed, merge into a continuous tube, but they seem also to merge with the spherical walls, which, as above remarked, are distinct from one another.

The walls of the cloacæ are pierced by closely arranged round pores by which the cloacal tube communicates with the cavity of the sphere. The latter communicates with the exterior by means of the large spout-like ostia, which are few in number and fairly constant in arrangement. The outer walls of the spheres are probably solid (i. e., without pores). In some specimens the wall clearly appears to be solid, but in others the evidence is more ambiguous. In no instance has conclusive evidence of porous structure come to light, such as is unquestionably presented by the cloacal tube. The large ostia probably furnished all the direct communication that was needed between the internal cavity, which, save for the cloacal tube, appears to have been empty, and the external medium. Indirect communication was furnished through the cloacæ. The cloacæ also served to connect with one another the several units between which direct communication seems to have been wanting.

The interesting fossil for which this generic name is introduced resembles several established genera, while presenting characters incompatible with any of them. Probably that whose relationship is most close is Steinmann's genus *Sollasia*, from the province of Asturias, in Spain. *Heterocalia* differs from *Sollasia* in the fact that the successive oscula are connected by internal walls into a central tube surrounding the cloacæ, whereas in *Sollasia* the central cavity is unoccupied. There is no inclosed cloacæ, and the oscula are not connected.

From *Amblysiphonella* the present type differs in being more distinctly composed of separate segments. This is shown by the fact that the lower wall of each spherical portion is repeated, so that where two units are in contact they are separated by a double partition. In *Amblysiphonella* the upper surface of one segment forms the lower boundary of the succeeding one. The party wall is not double, and the internal or cloacal wall connects above, but not below, with the outer wall. The interior of *Amblysiphonella* is more or less vesiculose, which is not the case with *Heterocalia*. Furthermore, the latter appears to have spout-like ostia but not dermal pores, whereas *Amblysiphonella* has dermal pores but no ostia. Much the same differences exist between *Heterocalia* and *Sebargasia*.

Another related genus is Waagen and Wentzel's *Steinmannia*, from the Permian of India. Here again the Kansas form is distinguished by having ostia without pores, instead of pores without ostia, and there are also no internal vesicles. There seems to be the further difference that the party wall is double in the present genus and in *Steinmannia* single, as in *Amblysiphonella* and *Sebargasia*.

*Type of the genus.*—*Heterocalia beedei*.

## HETEROCCELIA BEEDEI, new species.

Plate XIV, figs. 1-8.

1900. *Amblysiphonella prosseri* (part) BEEDE. Univ. Geol. Surv. Kansas, Rept., VI, p. 14, pl. 1, fig. 2f.

Many of the characters of this species are implied in the foregoing generic description. The constriction marking the union of two adjacent cells is deep and the general shape strongly moniliform. The stems are usually straight, but sometimes much contorted, and a few instances have been noted in which branching occurs. The size of the individual segments is rather small, seldom exceeding 10 mm. The osculum is large. The ostia are also rather large and spout-like. They are few in number and rather uniform in size and distribution. It is difficult to determine the exact number, but there seem to be six or eight, arranged transversely at nearly equal intervals, usually along the median line. Frequently the arrangement of these structures is sufficiently systematic for those of several consecutive chambers to form longitudinal rows.

If there is little doubt that this is the same form which Mr. Beede identified as *Amblysiphonella prosseri* in the work cited above, there can be no question that it belongs to a different species as well as to a different genus from the form described by Clarke.

*Locality and horizon.*—Allen limestone; cut on the Santa Fe railroad, 6 miles southwest of Chanute, Kansas.

*Type-specimens.*—Cat. No. 53471, U.S.N.M.

## MÆANDROSTIA, new genus.

This type consists of subcylindrical, stem-like, more or less bent, occasionally branching bodies. A central tube-like cloaca traverses the entire axial portion. The rather thick walls are intersected by vermiform chambers, which communicate with the surrounding median through numerous circular ostia, and with each other and with the cloaca by means of frequent though irregular apertures. The partitions between adjacent chambers, between the chambers and the cloaca, and between the chambers and the exterior are of the same character, apparently structureless and imperforate.

Though both sponges are at present preserved as carbonate of lime, *Calocladia*, in strong contrast with *Mæandrostia*, retains its spicular mesh-like structure, while the walls of the latter are to all appearance solid and structureless. In this respect *Mæandrostia* agrees with *Heterocelia*, and also in the general plan of construction, consisting, as it does, of separate though irregular chambers.

*Heterocelia* is so related to other genera which are usually looked upon as belonging to the Calcispongiæ that it can pretty safely be regarded as belonging to the same group. On account of its re-

semblance to *Heterocalia* and its difference from *Calocladia* it seems probable that *Maandrostia* also is one of the Calcispongiae.

*Maandrostia* more nearly resembles a sponge from the Guadalupe Mountains for which I have proposed the name *Cystothalamia* than any other genus known to me. Some of the differences which can be noted are these: *Cystothalamia* seems to be without a persistent central cloaca. The outer wall appears to be porous instead of solid. The ostia are prolonged as spout-like projections. The chambers produce swellings upon the exterior, to which they give a cystose appearance. The differences last mentioned may perhaps be regarded as only specific, but the first two are clearly generic. The material from the Guadalupe Mountains, however, is not well preserved, and it is impossible to state with complete certainty that there is no persistent cloaca, though the porosity of the outer wall is open to but little question. It hardly seems permissible, therefore, to regard the present type as generically the same as *Cystothalamia*.

*Type of the genus.*—*Maandrostia kansasensis*.

MÆANDROSTIA KANSASENSIS, new species.

Plate XV, figs. 1-7.

The form for which this name is proposed consists of slender, sub-cylindrical, occasionally branching bodies, which rarely exceed 13 mm. in diameter, but are often much smaller. As a rule they are nearly straight, but may be considerably contorted. The exterior is made irregular by inequalities of growth, and further roughened by large numbers of ostia, some of which appear to have slightly elevated margins. The ostia are circular, and average about 0.75 mm. in diameter. The interior is occupied by a central tubular cloaca, which apparently passes uninterruptedly through the complete length of the stem. The space between the cloaca and the periphery is filled in by vermiform chambers, which communicate with the exterior by means of the ostia and also intercommunicating with each other and with the cloaca by frequent irregular apertures in the walls. In different specimens, and probably in the same specimen at different points, this structure while the same in principle varies considerably in detail. A tube-like cloaca is usually a striking feature, but occasionally it is hardly to be distinguished from the generally irregular porous structure. The cloaca varies considerably in size, sometimes occupying less than one-third the entire diameter, at others having only a thin rim of wall about it. Similarly, in some sections the partitions are so developed at the expense of the chambers that the stem appears to be well-nigh solid. In others the partitions are thin and disconnected, leaving the interior all but open.

The walls appear structureless, and but for the openings already described are imperforate. The outer wall especially is pierced by

ostia, though not by pores, and against the surrounding matrix makes a sharply defined if somewhat irregular boundary.

*Locality and horizon.*—Allen limestone; cut on the Santa Fe Railroad, 6 miles southwest of Chanute, Kansas.

*Type-specimens.*—Cat. No. 53468, U.S.N.M.

STEINMANNIA BENJAMINI, new species.

Plate XV, fig. 8.

Of this species we have but a single specimen, exposed on a fractured rock surface. It consists of spheres placed end to end and partially embracing, so that an elongate subcylindrical body is produced, with more or less pronounced constrictions which mark the constituent segments. The theoretical spheres overlap so that usually the height of each chamber is only about half of the width. The party wall is single, formed by what was the terminal wall of the preceding segment. The constituent spheres vary in size between wide extremes and the growth of the organism as a whole is contorted and irregular. The length of the fragment is 55 mm. and the greatest diameter 10 mm. The interior of the chambers is almost empty, and I am not entirely satisfied that such apparent partitions as occur are not either adventitious or due to chambers coordinate with the larger ones. Presumably each chamber communicated with those adjacent by means of a central osculum, but this is not shown by the fracture section of our specimen. The walls are perforated by numerous large pores, but only one size of these has been observed, though thin sections might show others. Chambers communicate by means of these pores as well as by the oscula.

One feature of the specimen should not be passed over, though it may be adventitious. On both sides, following their windings rather closely and separated from the perforate wall by a narrow interval filled with matrix, is a thin outer wall (?) of the same general character as the inner one but imperforate.

It seems probable that this form belongs to the Salt Range genus *Steinmannia*, though it shows certain differences which if real are important. Oscula appear to be absent, but might readily fail to be shown by the specimen in its present condition. The rarity or absence of internal vesicles may be only a specific character, and can hardly be regarded as invalidating the generic identification. The most important difference doubtless is the apparent presence of but one set of perforations, and this is also the most well established. Aside from *Steinmannia*, the genus which the present form most resembles is *Sollasia*, and from *Sollasia* it differs importantly in the absence of ostia and the presence of perforations. If not a *Steinmannia* the present form is, therefore, probably a new genus, but I would certainly regard it as inadvisable to introduce a new generic term under present circumstances.



*Steinmannia benjamini* is clearly more closely related to *S. salinaria* of the two Indian species. It is distinguished by the less extensive development of internal vesicles, the presence apparently of pores of but one size, and the fact, so far as I can determine from the figures, that they are larger than those of the Indian species. The American form is also as a whole smaller.

It gives me great pleasure to name this species in honor of Dr. Marcus Benjamin, editor of the U. S. National Museum.

*Locality and horizon*.—Allen limestone: cut on the Santa Fe Railroad, 6 miles southwest of Chanute, Kansas.

*Type-Specimen*.—Cat. No. 53467, U.S.N.M.

#### CŒLOCLADIA, new genus.

Of this genus only a single species is known, and consequently only a partial generic description can be drawn up embodying those features which are shown by the form in question and which would presumably be possessed by congeneric species.

The growth is more or less arborescent, the branches cylindrical, with a large, uninterrupted cloaca. The walls are more or less thick, composed of consolidated spicules, probably tetracts, and pierced by numerous ostia, which sometimes ramify toward the outer surface. In the typical species the ostia are extended outward as spiniform processes. An epidermal layer of some sort was probably present.

The specimens representing this genus are preserved in such a different manner from those of the associated *Heterocolia*, which probably represents the Sycones of the Calcspongiae, that they may justly be inferred to belong to the Pharetrones, or else, though at present calcareous in chemical composition, to the Silicispongiae. The Pharetrones seem largely restricted to the Mesozoic, and upon the whole it is rather more probable that the present type belongs to the Silicispongiae. The spicular structure and the general arrangement of the canal system seem to make it probable that it is related to the Lithistida, rather than to the Hexactinellida. Owing to the difficulty of determining the exact character of the spicular element it is impossible to reach a satisfactory conclusion in regard to the more intimate relationship of *Cœlocladia* among the Lithistida. It is, however, distinct from a considerable number of genera with which comparisons have been made, chiefly in the cylindrical mode of growth. *Doryderma* is like it in this respect, but probably has a different spicular element and possesses a large number of axial canals instead of a large central cloaca. *Cylindrophyma*, of the upper Jurassic, is perhaps the most closely similar in every respect. Apparently the spicular unit and mode of consolidation are different in the present form.

*Type of genus*.—*Cœlocladia spinosa*.

## CŒLOCLADIA SPINOSA, new species.

Plate XVI, figs. 1-7.

This species consists of rather straight cylindrical fragments which rarely exceed 10 mm. in diameter. They are calibrated, the inner cavity having, on well-preserved specimens, sharply defined straight boundaries essentially parallel to the outer circumference. The thickness of the walls varies greatly in different specimens. It is rarely equal to the diameter of the cloaca and is sometimes quite thin. The external surface is roughened by the development of great numbers of spiniform ostia, whose size can not well be stated because they taper toward the outer end. The wall structure consists of a spicular network which it is difficult to analyze into its individual elements. The spicules appear to be rather large and somewhat irregularly cemented one to another by the extremities of their arms. As combinations of three rays diverging at approximately equal angles are of frequent occurrence, it is probable that the unit is a tetract. There seems to have been a dermal layer covering the exterior, as the outline of this surface against the inclosing rock is smooth (aside from the ostia). The inner wall bounding the cloaca, however, is minutely ragged, owing to the projecting rays of the spicules. The spicular layer of which the walls consist is rather open and is pierced by the tubular ostia, which apparently, after passing part way through to the outer side, ramify more or less, decreasing in diameter in the process.

These bodies occur in lengths up to 55 mm. and more, but seldom show signs of branching. In some cases, however, they appear to have branched rather freely, and perhaps the original growth was distinctly ramose, although at present it seems improbable that they formed extensive dendroid growths.

*Locality and horizon.*—Allen limestone; cut on the Santa Fe Railroad, 6 miles southwest of Chanute, Kansas.

*Type-specimens.*—Cat. No. 53469, U.S.N.M.

## HELIOSPONGIA, new genus.

This genus includes rather large dendroid sponges having a persistent central cloaca and a hexactinellid spicular unit. The branches are cylindrical, freely dividing, more or less completely coalescent when by chance they come into contact. The cloaca is rather small and apparently uninterrupted and continuous from top to bottom. The spicules are so oriented that their arms are rather regularly continuous in longitudinal and radiating lines. The third set of rays should make concentric lines, but although suggestions of regular concentric structure are not wanting, it is not conspicuous in the thin sections seen. It is, however, a striking feature of weathered



specimens. The longitudinal lines are slightly oblique, rising from the cloacal to the exterior surface, and probably slightly bending outward as they go. The transverse lines are also oblique and curved, having their convex sides uppermost and passing downward from the cloaca to the exterior. Between the arms of the large spicules thus disposed are freely connecting radial canals which open upon the outer surface in small circular pores. What I regard as true ostia are absent.

In general character this genus is very suggestive of *Catocladia*, but after due consideration I am fairly satisfied that they are distinct. As to the specific distinction of the genotypes there can be no question. Both have somewhat the same mode of growth; the spicules in both may possibly be hexacts, although in *Catocladia* it seemed more probable that they are tetracts. They are of much larger size in *Heliospongia ramosa* and their arrangement is also much more regular. In *Catocladia spinosa* there is hardly ever a trace of the longitudinal and radial lines which make such a striking feature in the structure of *Heliospongia ramosa*. The latter does not show the spine-like ostia of *Catocladia*, but this would probably be only a specific difference were it not that true ostia, I believe, are entirely absent from *Heliospongia* as well as the large canals which lead from them, for I can not regard the relatively large canals which interrupt the spicular network in *Catocladia* and terminate on the surface in spout-like ostia as homologous with the relatively small openings which pass between the arms of the regularly arranged spicules in *Heliospongia* and open upon the surface in the characteristic pores.

*Type of the genus.*—*Heliospongia ramosa*.

HELIOSPONGIA RAMOSA, new species.

Plate XVI, figs. 8, 9; Plate XVII.

This species forms large bushy bodies consisting of freely branching cylindrical stems which attain a diameter of 23 mm., but are usually somewhat smaller. Sometimes the branches are in contact, in which case they appear to coalesce, producing, temporarily at least, somewhat flabelliform shapes. The individual branches are pierced, probably from end to end, by cylindrical cloacæ, which are relatively of variable size, but usually, if not always, less than one-third the entire diameter.

The spicular element is large and without much doubt a hexact. The combined effect of the spicules is to produce more or less continuous radiating and longitudinal lines. The radiating lines are oblique, with the outer end lower than the inner, and they are somewhat curved, the convex side uppermost. The longitudinal series of rays are also probably somewhat oblique, sloping outward very gradually

as they rise from the rim of the cloaca, and probably slightly curving in the process. This arrangement is regular and tends to produce radiating pores from the cloaca to the periphery. Canals or chambers, properly speaking, appear to be absent. What look like vermiform canals are probably mere color markings, which wind among the spicules without interrupting them. These radiating pores produce upon the outer surface small, more or less circular openings, but ostia, strictly speaking, are probably absent. Certain larger openings appear to be superficial and to be produced by the absence of a spicular arm, such as in other instances serves to separate adjacent pores.

*Locality and horizon.*—Allen limestone; cut on the Santa Fe Railroad, 5 miles southwest of Chanute, Kansas.

*Type-specimens.*—Cat. No. 53472, U.S.N.M.

HELIOSPONGIA RAMOSA, var. PARALLELA, new variety.

Plate XVI, fig. 10, Plate XVIII.

This form seems to agree in all respects with the foregoing except in the mode of growth, the typical one bifurcating freely while the present variety appears to have a principal stem which gives off long, parallel branches.

*Locality and horizon.*—Allen limestone; cut on the Santa Fe Railroad, 6 miles southwest of Chanute, Kansas.

*Type-specimen.*—Cat. No. 53473, U.S.N.M.

MYALINA WYOMINGENSIS Lea.

Plate XIX, figs. 2, 3.

1853. *Modiola wyomingensis* LEA, Acad. Nat. Sci. Philadelphia, Jour., (2).

II, p. 205, pl. XX, fig. 1a.

1853. *Modiola minor* LEA, Acad. Nat. Sci. Philadelphia, Jour., (2), II, p.

205, pl. XX, fig. 2.

1886. *Modiola wyomingensis* CLAYPOLE, Wyoming Hist. and Geol. Soc.,

Proc. and Coll., II, Pt. 2, p. 247.

1898. *Myalina wyomingensis* WELLER, U. S. Geol. Surv., Bull. 153, p. 365.

1903. *Myalina wyomingensis* Girty, U. S. Geol. Survey, Prof. Paper 16, p. 422, pl. VIII, figs. 8-13.

“Testâ laevi triangulari, infernè compresso-alatâ; umbonibus elevatis, acutè angulatis.

“*Remarks.*—This is a broad flat species, very different from the *minor*, which is on the same specimen. These are parts of four distinct specimens on this small piece of slate, which is represented of the natural size.”

Lea's description and remarks are given above. Part of the inclosing rock having been removed the type-specimen proves to have the following characters:

Shell of medium size, subtriangular. Hinge but slightly shorter than the extreme width. Length and maximum width about equal. Umbonal ridge prominent, sigmoid, rounded sharply above, more

broadly below, where it is almost marginal, descending abruptly on the anterior side and very gradually behind. Beak nearly terminal, leaving, for the genus, a rather large lobe in front. Anterior outline sinuous, posterior outline gently convex. Anterior-superior angle rounded, posterior-superior angle obtuse. Inferior angle strongly rounded. Surface marked by sublamellose growth lines.

Several other specimens of various sizes and degrees of fragmentariness occur on the same slab. One of these, an imperfect mold of the exterior, seems to have been the original of Lea's *Modiola minor*. On the slab this specimen occurs near the posterior-superior angle of *M. wyomingensis*, but Lea shows it not in his figure of the whole slab but in a separate figure (fig. 2). Originally it bore a very close resemblance to Lea's illustration, but by removing part of the rock its appearance has been changed and its general resemblance of *M. wyomingensis* so enhanced as to leave scarcely a doubt that it belongs to the same species.

*M. wyomingensis* proves to have had a very extensive distribution, since what appears to have been the same species has been identified in Colorado. Lea's description of *Modiola minor*, which is here regarded as a synonym of *Myalina wyomingensis*, is as follows:

"Testâ infernè striatâ, ellipticâ, subplanulatâ; antico latere rotundato.

"*Remarks*.—A single specimen only was found of this species, and the umbones are obliterated. The lower part, as represented, is perfect, and very distinctly marked."

*Locality and horizon*.—Pennsylvania; Wilkesbarre, Pennsylvania.

*Type-specimens*.—Cat. Nos. 33899 and 33900, U.S.N.M.

#### MODIOLA MINOR Lea.

This species is based upon an external mold of an imperfect valve. The type-specimen occurs in association with *Myalina wyomingensis*, which appears to have been abundant, and as it agrees with that species in such characters as can be determined, it will be reasonably safe, as well as advantageous, to regard it as identical with *M. wyomingensis* and the name as a synonym.

#### DELTOPECTEN CLATHRATUS Lea.

Plate XIX, fig. 1.

1853. *Posidonia? clathrata* LEA, Acad. Nat. Sci. Philadelphia, Jour., (2), II, p. 205, pl. xx, fig. 1b.

The characters of this species are much in doubt. The types consist of two specimens lying close together and possibly even representing different valves of the same individual. One, which appears to be smaller but may only be imperfect, is almost certainly a representative of the genus *Deltopecten*. It has a broad, oblique cardinal area, with a large triangular cartilage pit beneath the beak. The

surface is marked by rather large, not very well-defined ribs arranged in pairs. So far as can be determined, this shell has all the characters of the right valve of *D. occidentalis*, which is the commonest Pennsylvanian species of *Deltopecten* and occurs associated with *M. wyomingensis* in Colorado.

The second specimen is obliquely crushed and at present furnishes scarcely a clue to the original shape. The sculpture consists of somewhat broad, flat ribs, which are strongly alternating, every other one being considerably larger.

I hardly know what course to regard best in the present contingency. It seems rather probable that both specimens belong to the same species, and I have little doubt that one of them is the form better known as *Ariculipecten occidentalis*. Unfortunately, *Deltopecten clathratus* antedates the description of *D. occidentalis* by several years, and it seems a pity to replace Shumard's name by that of a form which was inadequately described, whose characters are not readily determined from the types, and of whose identity with the better known form there may be some, if only slight, doubt.

*Locality and horizon*.—Pennsylvanian; Wilkesbarre, Pennsylvania.

*Type-specimen*.—Cat. No. 33901, U.S.N.M.

#### PLEUROTOMARIA ? DISTANS Lea.

Plate XIX, fig. 4.

1853. *Posidonia ? distans* LEA, Acad. Nat. Sci. Philadelphia, Jour., (2), 11, p. 205, pl. xx, fig. 3b.

"Like the above, there was but a small portion of a valve found. It has longitudinal striæ, somewhat like *perstriata*, but the striæ are more distinct and distant, amounting almost to ribs."

The original of Lea's *Posidonia ? distans* is such a mere fragment that it can hardly be stated with certainty to which division of the animal kingdom it belongs. It seems to be a portion of a whorl of a Pleurotomarioid, but nothing further can be said on that point. It has an irregular shape, with five gently curved, slightly converging liræ, which are thin, rounded, and separated by flattened interspaces several times their own diameter. The interspaces are not of equal sizes, and one, possibly two, are divided by liræ much finer than the others.

*Locality and horizon*.—Pennsylvanian, Wilkesbarre, Pennsylvania.

*Type-specimen*.—Cat. No. 33903, U.S.N.M.

#### EDMONDIA ? PERSTRIATA Lea.

Plate XIX, fig. 5.

1853. *Posidonia ? perstriata* LEA, Acad. Nat. Sci. Philadelphia, Jour., (2), 11, p. 205, pl. xx, fig. 3a.

The type of this species also is a mere fragment, unquestionably a pelecypod, probably the anterior extremity of some such form as

*Edmondia*, or possibly *Schizodus*. The liræ are fine, narrow, separated by relatively wide, flat interspaces or striae. The following is Lea's original account of this form:

"There is too small a portion of this species remaining on the surface of the specimen to characterize it by a proper diagnosis. Perhaps a third of the valve only remains, but this is perfect, and beautifully and transversely striate—the striae being parallel."

*Locality and horizon*.—Pennsylvanian, Wilkesbarre, Pennsylvania.

*Type-specimen*.—Cat. No. 33902, U.S.N.M.

HARTTINA INDIANENSIS, new species.

Plate XIX, figs. 6-15.

Shell terebratuliform, of medium size, oval to subpentagonal in outline, moderately convex or rather strongly gibbous. Greatest width about midway or a little below. A sinus is developed in the anterior half of the ventral valve which is sometimes broad and shallow, sometimes narrower and deeper. A corresponding fold seems to be lacking in the dorsal valve, of which the anterior portion is either slightly flattened or sometimes marked by another sinus, which runs but a short distance back from the anterior margin. The anterior outline is often more or less reentrant. Shell finely punctate.

Upon the interior the ventral valve is provided with two well-developed dental plates. In the dorsal valve there is probably a small hinge plate, from which proceeds a single rather short median septum about one-third as long as the entire valve. The auxiliary septa and platform characteristic of the genus *Diclasma* are not found.

The type material of this species was obtained from Pella, Marion County, Iowa, but the same form is represented also at Spergen Hill. I suspect that this species has sometimes been mistaken for *Diclasma turgidum*, which Hall and Clarke say is a typical *Diclasma*. It is possible that Whitfield's figures<sup>a</sup> and those of Cumings and Beede<sup>b</sup> copied from him were drawn from a specimen of the present species. It seems impossible to doubt that *Harttina indianensis* is a representative of a different genus from typical *Diclasma turgidum*, and even upon its external and specific characters it has not proved difficult to separate our material. *H. indianensis* is a larger form, less gibbous, seldom developing a sinus in the dorsal valve, and never developing a fold in the dorsal sinus, as is often the case in *D. turgidum*.

The configuration is so different from *Harttina anna*, the type of the genus and the only other North American species, that a discussion of the differences is not necessary. Although the configuration of the two species is so different, it seems necessary to refer the present

<sup>a</sup> Am. Mus. Nat. Hist., Bull., I, No. 3, 1882, p. 54, pl. vi, figs. 56-58.

<sup>b</sup> Dep. Geol. and Nat. Resources, Indiana, 30th Ann. Rept., 1906, p. 1309, pl. xxii, figs. 56-58.

one to *Harttina*, with which it agrees in internal structure certainly more closely than with any other Terebratuloid genus known to me. *Harttina indianensis* seems to be the first occurrence of this genus noted in the Mississippi Valley and is of somewhat especial interest on that account.

*Locality and horizon*.—St. Louis group; Pella, Marion County, Iowa.

*Type-specimens*.—Cat. No. 9288, U.S.N.M.

TEGULIFERA ARMATA, new species.

Plate XX, figs. 1-11.

Shell rather small, generally conical but very irregular. Rapidly expanding. The blunt cone has no distinct apex, and in fact the apex is more or less truncated, owing to what appears to be a surface of attachment.

The rim, especially toward the front and sides, is armed with large stout spines, which sometimes project upward and sometimes inward over the aperture. The rim is occasionally double, or even treble, consisting of independent concentric plates with spaces between. One or all of them apparently may be spiniferous, or the spines may project from the inner surface of the aperture. Sometimes, though very rarely, the development of the spines is attended by the appearance of costae, which are rather few and faint and restricted to the vicinity of the rim.

The rest of the surface is marked by fine, irregular incremental lines, by irregular varices of growth, and by a few small spines, which are not mounted upon spine bases. There are also frequently two or three irregularly disposed, buttress-like ridges, chiefly developed near the area of attachment, which are possibly spines adnate to the surface. Whether the consecutive lamellae which sometimes appear at the aperture are due to the overlapping of different layers of shell, as was observed by Schellwein in *Tegulifera deformis*<sup>a</sup>, or to a cessation of growth and a renewal within from a lower level than the aperture, a process not infrequently observable in the cup corals, has not been determined.

The dorsal valve is oval in shape, with a very short hinge line, nearly flat, slightly concave and of opercular form. It is situated well down near the base of the conical ventral valve and is marked only by fine incremental lines.

Apparently the ventral valve in process of growth wraps around the dorsal valve and around itself also. The lower portion of the ventral valve is, therefore, rather thick and in some cases diminished suddenly at the level of the dorsal, forming a sort of shelf or platform, from which some of the spines are developed. The thickened lower portion is sometimes occupied by a few large cysts.

<sup>a</sup> k. k. Geol. Reichsanstalt, Abhand., XVI, Heft 1, 1900, p. 59 et seq.



Internal structures not known, probably Productoid and not strongly developed.

This interesting type at once suggests the genus *Richthofenia*, and, as already pointed out by Schellwien, *Tegulifera* is without much question closely related to that genus. There is, however, a less complete development of vesicular tissue, joined with less pronounced internal structures, and above all an absence of the enveloped area and pseudodeltidium. *Tegulifera* may possibly be considered a *Productus* (*Marginifera*) which has assumed the habit of self-envelopment, while *Richthofenia* may possibly be that of an *Anlosteges* (*Strophalosia*) which has done the same thing.

*T. armata* is therefore a *Tegulifera*, rather than a *Richthofenia*, and apparently a true representative of Schellwien's genus. It is clearly distinct from the typical and previously only known species of *Tegulifera*, however. *T. deformis* comprises elongate, more slender shells, which are without apertural spines. *T. armata* seems also to be more completely self-invested, since the whole primitive shell appears to be enveloped by later deposits. At least I have seen no instance such as Schellwien has figured of the original ventral shell distinct from and surrounded by later growths.

*Locality and horizon*.—Pennsylvania: La Salle, Illinois.

*Type-specimens*.—Cat. No. 37758, U.S.N.M.

TEGULIFERA KANSASENSIS, new species.

Plate XXI, figs. 1-7.

This species is so related to the preceding one that to some the advisability of separating them may seem doubtful. It forms a larger and considerably more elongate shell, also one which is apt to be more irregular and contorted in its growth. Fine radial costae are usually present, though sometimes not very distinct; yet in most cases they can be observed. While it is true that the specimens of *T. kansasensis* are not preserved favorably for showing this feature, the large spines which project from the aperture of *T. armata* appear to be entirely lacking from them. On these accounts it has seemed desirable to separate the Kansas form as a distinct species. It appears to be more nearly allied to *T. typicalis* than *T. armata*, but is believed to be distinct, by reason of its more or less strongly costate surface.

It was this species which in listing the fauna of the Kansas Pennsylvanian in 1903 I referred to as *Proboscoidella* sp.<sup>a</sup> With but little question it should not be placed with *Proboscoidella*.

*Locality and horizon*.—Piqua limestone (?); 2½ miles west of Crane, Kansas.

*Type-specimens*.—Cat. No. 53470, U.S.N.M.

<sup>a</sup> U. S. Geol. Surv., Bull. 211, 1903, p. 79.

## PUGNAX WEEKSI, new species.

Shell large, varying in shape from subtriangular or subovate to subpentagonal, and from elongate to transverse. As a rule highly gibbous, but sometimes of lower convexity, probably as a persistence of an immature character, young shells being usually discoidal. Ventral beak large, pointed, suberect, flattened, and spreading at the sides. Foramen apparently triangular and open. Dorsal beak rather inconspicuous, and strongly incurved. Fold and sinus very strong, usually broad and subquadrate, but sometimes narrow and sometimes rounded; typically divided by a medium sulcus so that it bears two plications, but occasionally the sulcus is so faint that the fold appears to be simple. Much more rarely three plications are found upon specimens referred to this species. There is always one rather distinct lateral plication on each side of the fold, with usually a second, which is also sometimes distinct but may be obscure. All the plications are confined to the marginal portions of the shell, and they vary in different specimens not only as to distinctness but also as to being angular or rounded. In young specimens the shell is broadly oval and discoidal. The fold develops first, and later its median sulcus and the lateral plications.

Upon the interior the ventral valve is provided with dental lamellæ and the dorsal valve apparently with strongly diverging socket plates connecting with a hinge plate, which is also joined to a fairly long, high, median septum.

The posterior portion, especially of the ventral valve, is rather thick shelled, and moderately strong though not well-defined muscular imprints are retained in many instances.

In general appearance certain variants of this form are very suggestive of some species of Athyroids, as, for instance, *Composita trinuclea*, but more especially the forms grouped by Abich under the title *Spirigera protea*,<sup>a</sup> some of which, unlike *C. trinuclea*, have lateral plications. Aside, however, from the fact that these shells appear to be without spiralea, the configuration of the beak of the ventral valve indicates almost to a certainty that we have not to do here with an Athyroid. In fact, there can be but little doubt that this form is one of the Rhynchonellidæ. I have, however, been in some doubt as to what genus it would best be cited under. The choice seems to lie between *Rhynchonella* s. s. and *Pugnax*. The type species of *Rhynchonella* and *Pugnax* are very similar in external form, but *Rhynchonella loria* has a septum in the dorsal valve, while *Pugnax pugnus* is without that structure. In general appearance, therefore, *R. weeksi*

<sup>a</sup> Geologische Forschungen in den Kaukasischen Ländern, 1 Theil, Eine Bergkalkfauna aus der Araxesenge bei Djoulfa in Armenien, Wien, 1878, p. 52 et seq.

could be referred to either genus with almost equal propriety, but it possesses a pretty well-developed dorsal septum. On that account it might best, perhaps, be referred to *Rhynchonella*, although internally and externally it appears to be generically related to certain Carboniferous shells which Hall and Clarke have placed with *Pugnax*.

This species is so dissimilar to any of our American Rhynchonelloids that a comparison with them is scarcely necessary. Tschernyschew has figured a similar species from the Gschel-stufe of Russia as *Pugnax connivens*.<sup>a</sup> Some enlarged figures of *Pugnax dawsoniana* given by Davidson<sup>b</sup> resemble the present species in a remarkable degree. I have not had specimens of *P. dawsoniana* for comparison, but in view of the great difference in size of the two species, their wide geographic separation, and their probable great difference in geologic age and faunal association, such a comparison would, I believe, show them to be distinct. Hall and Clarke<sup>c</sup> have figured a form from Windsor, Nova Scotia, referring it to Davidson's species, which if correctly identified clearly shows that the latter is distinct from *P. weeksi*.

This species is named in honor of Mr. F. B. Weeks, who, together with Mr. W. F. Ferrier, collected most of our material from the phosphate beds of Idaho.

*Locality and horizon*.—Phosphate beds; <sup>a</sup> Montpelier, Idaho.

*Type-specimens*.—Cat. No. 53466, U.S.N.M.

OMPHALOTROCHUS FERRIERI, new species.

Shell rather small, consisting of 6 or 7 volutions. Diameter rarely if ever in excess of 30 mm. and usually 25 mm. or less. Height about half the diameter, variable. Spire low, with flatish top and rounded sides. Suture more or less strongly indented. Umbilicus deep and broad. Peritreme section from subcircular to transversely subelliptical, sometimes more or less quadrangular, with a distinct peripheral carina. The horizontal axis of the peritreme section is almost perpendicular to the axis of revolution. The upper external portion of the peritreme between the carina and the suture is gently convex. It is marked by a revolving ridge, which is sometimes very indistinct,

<sup>a</sup> Tschernyschew. *Com. Geol.* [St. Petersburg], Mem., XVI, No. 2, 1902, p. 483, pl. I, figs. 12, 13, 19, 20.

<sup>b</sup> Davidson. *Geol. Soc. London, Quart. Jour.*, XIX, 1863, p. 172, pl. ix, figs. 13, 14.

<sup>c</sup> Hall and Clarke. *Geol. Surv. New York, Pal.*, VIII, Pt. 2, pl. LXII, figs. 30-33.

<sup>d</sup> The term "phosphate beds" refers to a phosphate-bearing horizon in the Upper Carboniferous of Utah and Idaho which has not yet received a formation name. It will be fully described by Mr. F. B. Weeks in a forthcoming publication of the U. S. Geological Survey.—G. H. G.

situated rather nearer to the carina than to the suture. Both above and below the revolving ridge the shell is depressed, but it rounds out again at the suture. The lower sulcus, that between the carina and the revolving ridge, is narrower and stronger than the one above the latter. In proportion as these two sulci are evanescent, the revolving ridge is distinct or obscure, and to some extent the carina is affected in the same manner. Usually the upper part of one volution projects somewhat above the preceding one, so that the suture is well marked. The junction of the two volutions is sometimes more precise, in which case the suture is less depressed. When this occurs, and when the sides are unusually flat, without a distinct revolving ridge, shells have a rather individual expression, and they may possibly deserve to be discriminated as a variety. On the lower side the shell is gently convex and regularly so, except for a shallow groove, more distinct in some specimens than in others, which occurs a little below the carina and helps to define it. The upper internal side is gently concave, by reason of conforming its shape to the preceding volution.

This description refers to the later or mature volutions, the earlier ones showing considerable variation. The earliest whorls, one or two in number, appear to have been nearly circular and complanate, so that the spire was really depressed. Then the shell became flattened on top, with a relatively deep median depression. The upper surface of the volutions here lay in the same plane, which was perpendicular to the axis of revolution. Then the upper or exposed surface became considerably broader, oblique, and much less strongly and sharply depressed. Finally, an elevation of its median or submedian portion into a revolving ridge gave it in the main a gently convex, instead of a concave, outline. It is due to the character of the early development that the spire is truncated on top, as if broken off, and owing to the same cause young shells are more discoidal than mature ones.\*

The growth lines in some specimens extend forward from the suture for a short distance, bending backward with a sharp turn on the little shoulder, which occurs just below the suture. In others their course appears to be backward from the start. About midway on the outer side, or just above the revolving ridge, they again assume a forward direction, which is reversed at the carina or immediately above it. On the under side the lines are gently sigmoid, but more or less backward in general direction. Thus the aperture would have had a projecting outline at the carina, with a strong sinus above and a shallow one on the under side. The growth lines are fine and regular, becoming strongly fasciculate and more or less sublamellose in older volutions.

*Omphalotrochus ferrieri* is extremely variable in all its characters, passing into types which approach more or less closely to *O. conoidens*. It is named in honor of Mr. W. F. Ferrier, who, with Mr. F. B.

Weeks, collected most of our material from the phosphate beds of Idaho.

*Locality and horizon.*—Phosphate beds, Montpelier, Idaho.

*Type-specimens.*—Cat. No. 53465, U.S.N.M.

OMPHALOTROCHUS CONOIDEUS, new species.

Shell rather small, seldom exceeding 25 mm. in diameter, consisting of 7 or 8 volutions. Spire high, 19 mm. in one large specimen, but about 15 mm. in most cases. Umbilicus large, open. General outline conical, with sides nearly flat from apex to base. The peritreme section is approximately tetragonal, the upper and lower surfaces being more or less flat and subparallel, the inner surface nearly flat and perpendicular to them, and the outer also nearly flat, making an angle of about 60 degrees with the base. The junction of the external and lower surfaces forms a sharp, somewhat projecting carina, emphasized above and below by shallow indistinct grooves. A low ridge is usually developed on the external side of the peritreme slightly below the middle. Each of the mature volutions projects at its base a little beyond the upper edge of that which follows it. In but few instances is the upper edge of one volution flush with that which preceded, and in none has it been observed to extend beyond. The internal outline is circular, the shell being thickened to form the carina, and at the three other angles made by the surfaces of the peritreme.

The growth lines indicate that the aperture had a sinus above and below the carina, with a projection along it.

In most of the characters enumerated there is more or less variation. The lateral surface of the peritreme is usually slightly concave, but sometimes flat or convex. The lower surface also is in some cases more strongly rounded than in others, thus affecting the prominence and sharpness of the carina. The revolving ridge of the lateral surface is sometimes obscure, though usually distinguishable.

In all other characters, as well as some of those enumerated, this species is closely allied to *O. ferrieri*, so that the description of the former may be used for *O. conoideus*, with the following modifications: Like *O. ferrieri*, the spire of the present form is truncated, and owing to the same cause. The height of the peritreme is considerably greater than in *O. ferrieri*, because of the fact that the lateral surface is considerably oblique to the axis. It is, at the same time, slightly concave or flat, instead of being convex, although a slightly convex condition has sometimes been observed in shells referred to this species. The height of the shell is relatively considerably greater than in *O. ferrieri* for these reasons. The upper volution, instead of the lower, projects at the suture. The lower surface is flatter than in *O.*



*ferrieri*, which fact, joined with the flatter lateral surface, makes the carina sharper and more prominent.

Although the relationship of this form to *O. ferrieri* is very obvious, and although both forms vary so much that the extremes approach each other in some particulars, *O. conoidens* is a fairly well-marked form, deserving, it seems to me, specific distinction.

*Locality and horizon*.—Phosphate beds; Montpelier, Idaho.

*Type-specimens*.—Cat. No. 53464, U.S.N.M.

#### EXPLANATION OF PLATES.

##### PLATE XIV.

##### *Heterocelia beedei*, new species.

- FIG. 1. A fracture section through a specimen which seems to show branching  $\times 2$ .
2. A partly weathered specimen showing the position of the spout-like ostia which have been almost worn away.
3. Thin section longitudinally cutting a distorted specimen. This section shows the general structure and especially the perforated cloacal tube  $\times 3$ .
4. A weathered specimen showing the structure  $\times 2$ .
5. A fracture section through a specimen in rock, showing the length of the spout-like ostia  $\times 2$ .
6. A fracture section through a specimen  $\times 2$ .
7. A weathered surface showing several specimens and their manner of occurrence.
8. Longitudinal section through a specimen which has weathered free. This also shows the perforated cloacal tube  $\times 2$ .
- Allen limestone, Chanute, Kansas.

##### PLATE XV.

##### *Maandrostia kansascensis*, new species.

- FIG. 1. A thin section somewhat obliquely through a specimen. The cloaca shows in the lower part  $\times 2$ . The dark material is rock, and the light, fossil.
2. Another longitudinal section  $\times 2$ .
3. A well-preserved specimen partly overgrown by a bryozoan. Some of the ostia are shown.
4. Transverse section showing well-defined cloaca and about the usual amount of sponge tissue.
5. Longitudinal section showing the cloaca and irregularly chambered walls  $\times 2$ . As this is a ground surface, the sponge tissue, which is transparent in thin sections, is dark and the rock light.
6. A transverse section, also ground, so that the light material represents rock  $\times 2$ . The sponge tissue is here well developed with small chambers and cloaca.
7. A thin section, transverse, with very open structure  $\times 2$ .
- Allen limestone, Chanute, Kansas.

##### *Steinmannia benjamini*, new species.

8. A fracture section longitudinally through a specimen  $\times 2$ . The light-colored material is in this case rock.
- Allen limestone, Chanute, Kansas.



## PLATE XVI.

*Calocladia spinosa*, new species.

FIG. 1. Thin section, transverse, showing the well-defined cloaca surrounded by a thick wall composed of a mesh of consolidated spicules, pierced and interrupted by branching canals which terminate in spiniform ostia  $\times 4$ .

2. Part of a branch with the spiniform ostia well preserved.

3. Longitudinal section through a specimen similar to fig. 1,  $\times 4$ . The regularity of the spicules in this specimen suggests the structure of *Heliospongia*.

4. Longitudinal section through a branch showing the general relations of the cloaca, the walls, the branching canals, and the spiniform ostia  $\times 2$ . This is drawn from a polished surface and the spicules appear of a dark color instead of transparent, as in the thin sections.

5. Thin section longitudinal through another specimen  $\times 4$ .

6. Another thin section cut transversely through a branch  $\times 4$ .

7. A thin section tangential, showing the somewhat irregular spicular network  $\times 4$ .

Allen limestone, Chanute, Kansas.

*Heliospongia ramosa*, new species.

8. Longitudinal section through a fragment referred to this species.

9. Transverse section through the same  $\times 2$ . These sections show fairly well the regular arrangement of the large spicules. The cloaca, though shown in a general way, is not clearly defined.

Allen limestone, Chanute, Kansas.

*Heliospongia ramosa*, var. *parallela*, new variety.

10. Transverse section across one of the branches of the specimen represented on plate 5,  $\times 2$ . The structure here is of the same type as that shown by figs. 8 and 9.

Allen limestone, Chanute, Kansas.

## PLATE XVII.

*Heliospongia ramosa*, new species.

FIG. 1. The type-specimen, natural size, showing the large size, the branching habit of growth, and the regular arrangement of the large spicules such that their arms make transverse and longitudinal lines.

Allen limestone, Chanute, Kansas.

## PLATE XVIII.

*Heliospongia ramosa*, var. *parallela*, new variety.

FIG. 1. The type-specimen, natural size, showing the peculiar branching, different from the typical variety. A thin section from this specimen is illustrated on Plate XXV. This same slab shows several specimens of *Heterocelia beedci*.

Allen limestone, Chanute, Kansas.

## PLATE XIX.

*Dellopecten clathratus* Lea.

- Fig. 1. The typical specimen  $\times 2$ . These two shells possibly belong together. That to the right, which is clearly a right valve, shows the characteristic hinge structure of *Dellopecten*.

*Myalina wyomingensis* Lea.

2. The type-specimen, freed from the matrix by which it was partially concealed in the original figure.
3. The type-specimen of Lea's *Modiola minor*. The original, which is an external mold, crushed and imperfect, is probably a young example of *Myalina wyomingensis*.

*Pleurotomaria? distans* Lea.

4. The type-specimen  $\times 2$ . A mere fragment, probably of a gastropod, though originally placed with the pelecypods.

*Edmondia? perstriata* Lea.

5. The type-specimen  $\times 2$ . A mere fragment, probably the anterior end of a pelecypod.

Pennsylvanian, Wilkes-Barre, Pennsylvania.

*Hartina indianensis*, new species.

6. A specimen with rather indistinct dorsal sinus; ventral view.
7. Dorsal view.
8. Dorsal view of a specimen with distinct dorsal sinus.
9. Ventral view of same.
10. An ovate specimen with imperfectly developed sinus; ventral view.
11. Dorsal view.
12. Ventral view of a broad variety with distinct dorsal sinus.
13. Dorsal view.
14. Specimen with the posterior portion ground down to show the internal structures. The ventral valve is seen to have two strong dental plates. In the dorsal valve the section passes below (interior to) the short low medium septum  $\times 3$ .
15. Another specimen similarly prepared  $\times 3$ . The dorsal valve is seen to have a single septal plate, neither very long nor very high, without any trace of the lateral septa and platform characteristic of *Dielasma*. The section touches the apex of the ventral valve and shows the beginnings of the dental plates.

St. Louis group, Marion County, Iowa.

## PLATE XX.

*Tegulifera armata*, new species.

- Fig. 1. Dorsal view of a small specimen retaining both valves in place  $\times 2$ .
2. Ventral view  $\times 2$ .
  3. Anterior view of ventral valve of a specimen with apertural spines and basal ridges  $\times 2$ .
  4. Posterior view of same  $\times 2$ .
  5. Same, seen from below.

6. A characteristic specimen with both valves in place. Ventral view  $\times 2$ .
  7. Dorsal view showing the narrow hinge and the spines along the margin of the ventral valve  $\times 2$ .
  8. View obliquely down into the interior of a ventral valve, showing the spines developed within the cavity  $\times 2$ .
  9. A specimen showing faint costae. Dorsal view  $\times 2$ .
  10. Ventral view  $\times 2$ .
  11. Anterior view of a large specimen with concentric spiniferous layers at the aperture  $\times 2$ .
- Pennsylvanian, Lasalle, Illinois.

## PLATE XXI.

*Tegulifera kansascensis*, new species.

- FIG. 1. A slab of limestone containing two specimens. Side view showing one of them  $\times 2$ .
2. Side view showing both specimens. The apical portion has been broken off in both instances  $\times 2$ .
  3. Ventral view of apical cap of one of the specimens represented by figure 2. There seems to be a flattened area of attachment  $\times 4$ .
  4. View of internal or dorsal side of same  $\times 4$ .
  5. A large specimen preserved in a manner similar to the last. Posterior view with the apical cap attached  $\times 2$ .
  6. Lower or ventral side with apical cap attached  $\times 2$ .
  7. Same with apical cap removed. What is here shown is the inner surface of the dorsal valve with the ventral valve surrounding it  $\times 2$ .
- Piqua limestone, Crane, Kansas.